A review of species-limits in some *Cryptazeca* (Gastropoda: Azecidae)

Reconsideración de los límites entre especies en *Cryptazeca* (Gastropoda: Azecidae)

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ABSTRACT

Species-limits are reviewed for several taxa in the land-snail genus *Cryptazeca*, based mainly on measurements of shell size and shape. Compared to previous studies, larger samples of shells from more numerous populations were available for analysis. Widely overlapping ranges of variation in shell size and form in *C. monodonta* (from SW. France) and *C. kobelti* (NW. Spain) imply that these allopatric taxa are likely to be conspecific, so the latter name is synonymised with the former. The species lives amongst leaf-litter in moist deciduous woodland. *C. subcylindrica* (SW. France) has shells that are similar to those of some populations of the allopatric and widely variable *C. vasconica* (NW. Spain), hence the latter name is synonymised with the former. The species lives amongst debris in crevices of limestone rocks, sometimes inside caves. An identification key to the species is presented, based on characters of adult shells. The proposed taxonomic changes have implications for the conservation status of the taxa involved, since their current threat status on the IUCN Red List should probably be reduced now that each of the two species recognised as valid has a wider range and more populations known.

RESUMEN

Se realiza una reconsideración de las características que permiten separar especies dentro del género de moluscos terrestres *Cryptazeca*, basados en la forma y medidas de la concha. En comparación con otros estudios previos, este análisis se ha efectuado sobre un mayor número de ejemplares y procedentes de un mayor número de poblaciones. El amplio solapamiento observado en lo concerniente al tamaño y forma de la concha en *C. monodonta* (del SW. de Francia) y *C. kobelti* (NW. España) implica que estos dos taxones alopátricos son muy probablemente conespecíficos, por lo que este último nombre es incluido en la sinonimia del primero. Esta especie vive entre la hojarasca en suelos húmedos de bosques caducifolios. Por otro lado, las conchas de *C. subcylindrica* (SW. Francia) son similares a las de varias poblaciones de la muy variable y alopátrica *C. vasconica* (NW. España), por lo que este último nombre se incluye en la sinonimia de *C. subcylindrica*. Esta especie vive entre los restos vegetales acumulados en fisuras de rocas calizas, y a veces también dentro de cuevas. Se presenta una clave para la identificación de las especies del género, basada en los caracteres conquiológicos de individuos adultos. Los cambios taxonómicos propuestos tienen implicaciones sobre el estatus de conservación de los taxones implicados, de forma que la categoría de amenaza con que figuran en la lista roja de la UICN deberá probablemente ser menor, ya que ambas especies reconocidas como válidas tienen ahora un mayor rango de distribución y se conocen un mayor número de poblaciones.

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INTRODUCTION

The genus *Cryptazeca* De Folin & Bérillon, 1877 comprises small land-snails occurring in woodland, among limestone rocks and in cave habitats in SW. France and parts of NW. Spain. Different authors have regarded them as members of the Ferussaciidae in the superfamily Achatinoidea of the infraorder Sigmurethra (Schileyko, 1976, 1999; Bank, Bouchet, Falkner, Gittenberger, Hausdorf, von Proschwitz and Ripken, 2001; Falkner, Bank and von Proschwitz, 2001; Falkner, Ripken and Falkner, 2002) or Cochlicopidae within the infraorder Orthurethra (Zilch, 1959; Gittenberger, 1983; Gómez and Angulo, 1987, 1990; Gómez, 1990b, 1991). The uncertainty about their wider relationships has been resolved recently by Madeira, Elejalde, Chueca and Gómez (2010) from a phylogenetic study of rRNA sequence data. They demonstrate a sister-group relationship of *Cryptazeca* and *Hypnophila*, both of which are closely allied to *Azeca* (Azecidae), but placed more distant from *Cochlicopa* and far from *Ferussacia*.

The review by Gittenberger (1983) recognised four species of *Cryptazeca*, with two restricted to SW. France in Dept. Pyrénées-Atlantiques (*C. monodonta* (De Folin & Bérillon, 1877), *C. subcylindrica* De Folin & Bérillon, 1877) and two restricted to parts of NW. Spain from Prov. Asturias eastwards to Prov. Navarra (*C. vasconica* (Kobelt, 1894), *C. kobelti* Gittenberger, 1983). Since then two more species have been described from caves in NW. Spain (*C. spelaea* Gómez, 1990a; *C. elongata* Gómez, 1990b). A total of six species has therefore been recognised in recent literature (e.g. Gómez, 1990b; Fauna Europaea Database Project, 2011). Detailed studies of the genital anatomy of *C. monodonta* and *C. vasconica* (Gómez and Angulo, 1987; Gómez, 1991) revealed that they differ significantly in penis structure. Both of the cavernicolous species *C. spelaea* and *C. elongata* also show peculiar features in their genital anatomy (Gómez, 1990a, 1990b), as well as much larger shells than those of all congeners from open habitats. The existence of distinct species is also supported by finds of two pairs of taxa living together at the same localities, *C. monodonta* with *C. subcylindrica* in SW. France (Gittenberger, 1983; at Grotte de Sare: Holyoak and Seddon, 1985) and *C. kobelti* with *C. vasconica* in Spain (S. of Orduña: Gittenberger, 1983; Dance, Holyoak, Seddon and Tattersfield, 1986).

When Gittenberger (1983) wrote his seminal review, most of the specimens available to him were obtained in the nineteenth century. Efforts to refind three of the species were unsuccessful at that time, so his more recent material consisted only of eight shells of *C. vasconica*. However, all of the species were refound in the following two decades, some of them at several localities (Holyoak & Seddon, 1985; Dance *et al.*, 1986; Gómez and Angulo, 1987; Altonaga, Gómez, Martín, Prieto, Puente and Rallo, 1994). The present authors' fieldwork from 2001-2011 has added more specimens and additional localities, but also disclosed populations of *Cryptazeca* that could not be identified to species using the key to shells presented by Gómez (1990b). Our initial suspicions that undescribed species are involved were set aside when fuller studies showed greater variability in shell size and form in the known species than is recognised in existing literature. In particular, the allopatric *C. monodonta* and *C. kobelti* appear to be linked by many intermediate shells and the very variable *C. vasconica* has populations linking it to the allopatric *C. subcylindrica*. This paper therefore reconsiders species-limits in these two species pairs, based on many more specimens than were available for Gittenberger's (1983) review (cf. Table II).

MATERIAL AND METHODS

Field collections by the authors were made by direct searching and by sieving leaf-litter and other debris using nested 2.0 and 0.5 mm mesh sieves to obtain "fines" that were subsequently searched

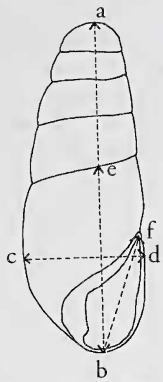

Figure 1. Locations of shell measurements given in Tables I and II. a-b, shell height (SH), c-d, shell breadth (SB), b-e, height of body whorl (BH), b-f, height of aperture (AH).
Figura 1. Representación de las medidas de la concha recogidas en las Tablas I y II. a-b, altura de la concha (SH), c-d, anchura de la concha (SB), b-e, altura de la última vuelta (BH), b-f, altura de la abertura (AH).

at low magnifications using a stereomicroscope. All shells found were retained, to avoid possible bias in favour of large or well preserved specimens. Localities and altitudes were recorded from 2007 onwards using Garmin handheld GPS, accurate to within 10 metres. From 2007 onwards sites were also given consecutive serial numbers (e.g. E153). Habitat notes (including bedrock type and vegetation) and associated Mollusca were recorded at all sites.

Adult snails could readily be distinguished from immatures by the thickened edge to the peristome. Drawings of shells were prepared using a drawing tube on a Meiji RZ series stereomicroscope. Figure 1 shows the locations of measurements of shell height, shell breadth, body-whorl height and aperture height. These measurements were made on adult shells using Infinity Analyze© software on images taken with an Infinity 1 camera on a Meiji RZ series stereomicroscope. The measurements on the images were reproducible to ± < 0.01 mm, but unavoidable slight tilting of the shells almost certainly caused minor additional loss of precision.

Details of the material studied are listed in the Appendix. Specimens reported by HOLYOAK & SEDDON (1985) and DANCE *ET AL.* (1986) were studied on loan from the Dept. of BioSYB of National Museum and Gallery of Wales, Cardiff, U.K. (NMW.Z). Almost all other specimens studied are retained in the Collection of G.A. and D.T. Holyoak.

RESULTS

Measurements of shells are listed in Table I and summarised and compared with those from the literature in Table II. Figure 2 gives drawings of representative shells of each taxon.

AZECIDAE Watson, 1920
Cryptazeca De Folin & Bérillon, 1877
Cryptazeca monodonta (De Folin & Bérillon, 1877)

Azeca monodonta De Folin & Bérillon, 1877, *Bull. Soc. Borda Dax*, 2 (1): 199, pl. [1], figs 1, 2 [Type locality: "Bramepan", St. Pierre-d'Irube SE. of Bayonne, Pyrénées-Atlantiques, France]. See GITTENBERGER & KOSTEN (1983) for bibliographical details.

Table I. Measurements (mm) of shells of *Cryptazeca*. N = number of intact adult shells measured, SH = shell height, SB = shell breadth, BH = body-whorl height, AH = aperture height; see Fig. 1 for locations of measurements.
Tabla I. Dimensiones (mm) de las conchas de Cryptazeca. *N = número de conchas adultas intactas medidas, SH = altura de la concha, SB = anchura de la concha, BH = altura de la última vuelta, AH = altura de la abertura; ver Fig. 1 para la forma en que se han tomado las medidas.*

Species	Region	Locality		N	SH	SB	BH	AH	SH/SB
C. kobelti	Prov. Alava	3 km S. of Orduña	mean	23	3.721	1.734	2.486	1.766	2.147
C. kobelti	Prov. Alava	3 km S. of Orduña	s.d.	23	0.151	0.056	0.099	0.055	0.053
C. kobelti	Prov. Alava	3 km S. of Orduña	min.	23	3.440	1.631	2.259	1.646	2.070
C. kobelti	Prov. Alava	3 km S. of Orduña	max.	23	4.014	1.834	2.702	1.888	2.276
C. kobelti	Prov. Alava	4 km S. of Orduña		1	3.784	1.769	2.397	1.746	2.139
C. kobelti	Prov. Alava	4 km S. of Orduña		1	3.326	1.591	2.221	1.598	2.091
C. kobelti	Prov. Alava	4 km S. of Orduña		1	3.418	1.639	2.201	1.542	2.085
C. kobelti	Prov. Guipúzcoa	E. of Maduriaga		1	3.505	1.652	2.313	1.650	2.122
C. kobelti	Prov. Guipúzcoa	E. of Maduriaga		1	3.575	1.626	2.296	1.620	2.199
C. monodonta	Pyrénées-Atlantiques	Grotte de Sare	mean	56	3.574	1.641	2.406	1.674	2.178
C. monodonta	Pyrénées-Atlantiques	Grotte de Sare	s.d.	56	0.145	0.044	0.102	0.062	0.058
C. monodonta	Pyrénées-Atlantiques	Grotte de Sare	min.	56	3.261	1.532	2.133	1.540	2.065
C. monodonta	Pyrénées-Atlantiques	Grotte de Sare	max.	56	3.938	1.732	2.587	1.809	2.325
C. monodonta	Pyrénées-Atlantiques	1 km SW. of Ustaritz	mean	16	3.301	1.545	2.316	1.611	2.138
C. monodonta	Pyrénées-Atlantiques	1 km SW. of Ustaritz	s.d.	16	0.089	0.040	0.071	0.053	0.053
C. monodonta	Pyrénées-Atlantiques	1 km SW. of Ustaritz	min.	16	3.202	1.470	2.163	1.538	2.046
C. monodonta	Pyrénées-Atlantiques	1 km SW. of Ustaritz	max.	16	3.507	1.603	2.418	1.719	2.242
C. subcylindrica	Pyrénées-Atlantiques	Grotte de Sare	mean	6	3.560	1.338	2.273	1.382	2.662
C. subcylindrica	Pyrénées-Atlantiques	Grotte de Sare	s.d.	6	0.119	0.037	0.382	0.088	0.062
C. subcylindrica	Pyrénées-Atlantiques	Grotte de Sare	min.	6	3.465	1.295	2.013	1.315	2.565
C. subcylindrica	Pyrénées-Atlantiques	Grotte de Sare	max.	6	3.762	1.400	3.030	1.554	2.747
C. vascanica	Prov. Asturias	Desfiladero de las Beyos	mean	7	4.386	1.708	2.660	1.670	2.568
C. vascanica	Prov. Asturias	Desfiladero de las Beyas	s.d.	7	0.212	0.023	0.091	0.034	0.102
C. vasconica	Prov. Asturias	Desfiladero de los Beyas	min.	7	4.205	1.670	2.538	1.616	2.482
C. vascanica	Prov. Asturias	Desfiladero de los Beyos	max.	7	4.708	1.736	2.764	1.704	2.715
C. vascanica	Prov. Cantabria	NW. of Otañes		1	2.982	1.194	1.783	1.167	2.497
C. vasconica	Prov. Cantabria	NW. of Otañes		1	2.950	1.125	1.744	1.165	2.622
C. vasconica	Prov. Cantabria	NW. of Otañes		1	3.018	1.254	1.802	1.172	2.407
C. vasconica	Prov. Cantabria	SE. of Llaguno		1	2.986	1.223	1.729	1.151	2.442
C. vasconica	Prov. Cantabria	SE. of Llaguno		1	3.114	1.277	1.973	1.182	2.439
C. vasconica	Prov. Cantabria	SE. of Llaguno		1	3.064	1.260	1.963	1.341	2.432
C. vasconica	Prov. Cantabria	3 km S. of Orduña		1	3.322	1.323	1.935	1.268	2.511
C. vasconica	Prov. Cantabria	3 km S. of Orduña		1	3.325	1.302	1.970	1.322	2.554
C. vascanica	Prov. Guipúzcoa	NE. of Aragotz		1	2.905	1.178	1.652	1.127	2.466
C. vasconica	Prov. Guipúzcoa	NE. of Aragotz		1	3.020	1.224	1.779	1.174	2.467
C. vascanica	Prov. Guipúzcoa	NE. of Aragotz		1	2.916	1.194	1.816	1.207	2.442
C. vasconica	Prov. Navarra	E. of Puerto de Usategueta		1	4.170	1.467	2.425	1.596	2.843
C. vasconica	Prov. Vizcaya	near Dima		1	2.918	1.205	1.885	1.243	2.422
C. vasconica	Prov. Vizcaya	near Dima		1	2.994	1.156	1.768	1.179	2.590
C. vasconica	Prov. Vizcaya	W. of Ranera	mean	17	3.251	1.309	1.943	1.298	2.485
C. vasconica	Prov. Vizcaya	W. of Ranero	s.d.	17	0.154	0.045	0.069	0.047	0.085
C. vasconica	Prov. Vizcaya	W. of Ranero	min.	17	3.072	1.226	1.834	1.221	2.357
C. vasconica	Prov. Vizcaya	W. of Ranero	max.	17	3.616	1.404	2.053	1.414	2.699

Table II. Summary of measurements (mm) of shells of *Cryptazeca* species and comparisons with data from literature. N = number of intact adult shells measured; SH = shell height; SB = shell breadth; measurements (mm) from literature are cited in the form in which they were published; measurements of the lectotype of *C. subcylindrica* are based on GITTENBERGER (1983: fig. 12).
Tabla II. Resumen de las medidas (mm) de las conchas de las especies de Cryptazeca *y comparación con los datos de la literatura. N = número de conchas adultas intactas medidas; SH = altura de la concha; SB = anchura de la concha; las medidas (mm) de procedentes de la bibliografía son citadas en la forma en que fueron publicadas; las medidas del lectotipo de* C. subcylindrica *se basan en GITTENBERGER (1983: fig. 12).*

Species	Source	N	SH range	SB range	SH/SB range	SH/SB mean ± s.d.
C. monodonta	Gittenberger, 1983	24?	3.15-3.8	1.55-1.7		
	Gómez, 1990b	?				2.23 ± 0.06
	this study	72	3.20-3.94	1.47-1.73	2.05-2.33	
C. kobelti	Gittenberger, 1983	4	3.5-3.7	1.65-1.7		
	Gómez, 1990b	?				2.16 ± 0.06
	this study	28	3.33-4.01	1.59-1.83	2.07-2.28	
C. subcylindrica	Gittenberger, 1983	20	3.5-4.55	1.25-1.5		
	ditto, lectotype	1	4.3	1.4	3.08	
	this study	6	3.47-3.76	1.30-1.40	2.57-2.75	
C. vasconica	Gittenberger, 1983	6	2.9-4.3	1.2-1.7		
	Gómez, 1990b	?				2.46 ± 0.11
	this study	48	2.91-4.71	1.13-1.74	2.36-2.84	
C. spelaea	Gómez, 1990a	16	7.25-8.15	2.60-2.90		
	Gómez, 1990b	16?				2.67 ± 0.11
C. elongata	Gómez, 1990b	4	6.20-7.00	2-2.35		2.93 ± 0.15

Cryptazeca kobelti Gittenberger, 1983, *Zool. Meded.*, 57 (23): 313 [Type locality: Conca d'Orduña, Spain].

C. kobelti was described from just four old shells from Conca de Orduña in Prov. Navarra (GITTENBERGER, 1983) [the actual localities were probably in an area that is now within Prov. Alava] and compared with *ca* 24 old shells of *C. monodonta*. The present study used 72 shells of *C. monodonta* (from 2 localities) and 28 of *C. kobelti* (from 4 localities in 2 areas). Based on the larger samples now available it is clear that these taxa overlap widely in shell size and form (Tables I, II; Fig. 2). The key by GÓMEZ (1990b) gave shell height/shell breadth as 2.2-2.35 in *C. monodonta* and 2.1-2.2 in *C. kobelti*, whereas our measurements give ratios respectively of 2.05-2.33 and 2.07-2.28 so that most individual shells are inseparable on this basis. In the original description of *C. kobelti*, GITTENBERGER (1983: 313) described *C. monodonta* as "more spindle-shaped and less pale in colouration (judging after only one fresh specimen of *C. kobelti* and several of *C. monodonta*)". However, in our material the shapes of individual shells of the two taxa can be closely matched (cf. Fig. 2). There is also no difference whatever in the brown coloration of shells of the two taxa when modern specimens collected alive are compared. Gittenberger's "fresh" shells must anyway have been about 90 years old when he studied them.

Locality data reported by ALTONAGA *ET AL.* (1994) for *C. kobelti* included sites in the Spanish Provinces of Guipúzcoa and Vizcaya situated between the type-locality near Orduña and the localities for *C. monodonta* in Dept. Pyrénées-Atlantiques

(Fig. 3A). Our few specimens from near Madariaga (Prov. Guipúzcoa) could only be identified arbitrarily as either *C. kobelti* or *C. monodonta*. Hence, it seems clear that *C. kobelti* should be regarded as a synonym of *C. monodonta*. The species lives amongst leaf-litter in moist deciduous woodland, including hillside *Fagus sylvatica* woods near Orduña (elevation *ca* 540-570 m) and near Madariaga (at elevations of 656 and 675 m), and more varied woodland with *Quercus*, *Acer*, *Fraxinus excelsior*, *Corylus avellana* and other trees and shrubs at Grotte de Sare (elevation *ca* 220 m). Most if not all the localities overlie limestone bedrock and there is much exposed rock at some of them, whereas several others lack rock exposures in the places where the species was collected alive.

Cryptazeca subcylindrica De Folin & Bérillon, 1877

Cryptazeca monodonta var. *subcylindrica* De Folin & Bérillon, 1877, *Bull. Soc. Borda Dax*, 2 (4): 443, pl. 3, fig. 6 [Type locality: "Bramepan", St. Pierre-d'Irube SE. of Bayonne, Pyrénées-Atlantiques, France]. See Gittenberger & Kosten (1983) for bibliographical details.

Ferussacia (*Hypnophila*?) *vasconica* Kobelt, 1894, *Icon. Land- & Süsswass.-Moll.*, (N.F.) 7 (1-4): 37, pl. 188, fig. 1200 [Type locality: Orduña, Prov. Alava, Spain].

Recent collections of *C. vasconica* show a wide range of variability in shell size and shape (Figs. 2A-F, Table I). In different populations the shell height ranges from 2.9-3.0 mm (N. of Araotz, Prov. Guipúzcoa) to a mean of 4.4 mm (Desfiladero de los Beyos, Prov. Asturias) and shell shape ranges from subcylindrical to narrowly conical or narrowly fusiform (Fig. 2). Shell colour is typically light brown (lighter than in *C. monodonta*), but colourless shells occur inside caves (Gómez, 1990b: 373; Altonaga *et al.*, 1994: 76). Measurements of our material of *C. subcylindrica* from near the Grotte de Sare (Dept. Pyrénées-Atlantiques) are within the overall range of shell size and shape found in *C. vasconica* (Table I, Fig. 2). The freshest empty shells (at least one collected alive) from Grotte de Sare include two that are pale brown and one that is almost colourless (part of NMW.Z. 1993.052.10530). As pointed out by Gittenberger (1983) and Gómez (1990b: 373), the transverse sculpture in *C. subcylindrica* is strong; on the freshest shells it is closely similar to that of *C. vasconica*. A single adult specimen from our easternmost Spanish locality for *C. vasconica* near the Puerto de Usateguieta (Prov. Navarra) is so close to the *C. subcylindrica* from Grotte de Sare in shell size and form (cf. Figs. 2F and 2G) that identifying them as separate species seems arbitrary.

The lectotype of *C. subcylindrica* figured by Gittenberger (1983: 314) is a very narrow shell (shell height/shell breadth 3.08), whereas the measurements he gives for other specimens widely overlap those of our material from Grotte de Sare. Although he reported the shell of that species as colourless, this is not true of some from Grotte de Sare, whereas some *C. vasconica* are colourless, as noted above. Hence most *C. subcylindrica* (including our material from Grotte de Sare) show shells that are within the range of variation found in different populations of *C. vasconica*, only the lectotype being notably narrow (although the *C. vasconica* shell from Puerto de Usateguieta approaches this with shell height/shell breadth of 2.84). It therefore seems better to regard these taxa as conspecific, with *C. vasconica* treated as a synonym of *C. subcylindrica* which has the older name. The alternative of dividing *C. vasconica* into several closely split species might eventually prove to be justifiable, but there are too many intermediate populations for this to be warranted on the basis of the shell data alone. Although anatomical and molecular comparisons are desirable, we have failed to obtain living *C. subcylindrica* on recent visits to sites near its French type locality.

C. subcylindrica sensu lato is an elusive snail that is usually found in small numbers in more or less shaded places

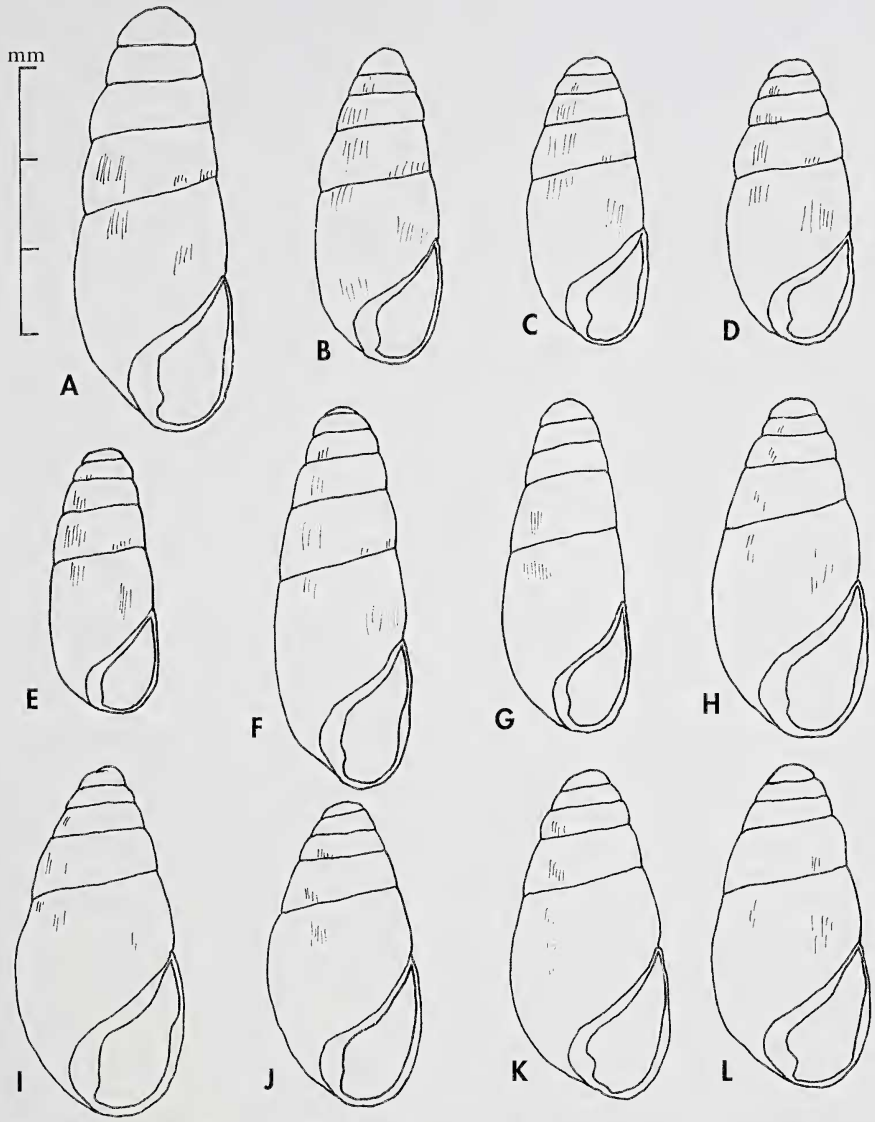

Figure 2. Drawings of representative shells of *Cryptazeca* species. A: *C. vasconica*, by San Ignacio turning, Prov. Asturias; B-D: *C. vasconica*, W. of Ranero, Prov. Vizcaya; E: *C. vasconica*, NE. of Araotz, Prov. Guipúzcoa; F: *C. vasconica*, Puerto de Usateguieta, Prov. Navarra; G: *C. subcylindrica*, Grotte de Sare, Pyrénées-Atlantiques; H: *C. monodonta*, Grotte de Sare, Pyrénées-Atlantiques; I: *C. kobelti*, 3 km along road S. of Orduña, Prov. Alava; J: *C. kobelti*, 4 km along road S. of Orduña, Prov. Alava; K: *C. kobelti*, site E149, E. of Madariaga, Prov. Guipúzcoa; L: *C. monodonta*, Grotte de Sare, Pyrénées-Atlantiques; all specimens are in the Collection of G.A. and D.T. Holyoak.

Figura 2. Dibujos de varias conchas representativas de las especies de Cryptazeca. *A:* C. vasconica, *de San Ignacio turning, Prov Asturias; B-D:* C. vasconica, *W. de Ranero, Prov. Vizcaya; E:* C. vasconica *NE. de Araotz, Prov. Guipúzcoa; F:* C. vasconica, *Puerto de Usateguieta, Prov. Navarra; G:* C. subcylindrica, *Grotte de Sare, Pyrénées-Atlantiques; H:* C. monodonta, *Grotte de Sare, Pyrénées-Atlantiques; I:* C. kobelti, *3 km por la carretera al S. de Orduña, Prov. Alava; J:* C. kobelti, *4 km por la carretera al S. de Orduña, Prov. Alava; K:* C. kobelti, *lugar E149, E. de Madariaga, Prov. Guipúzcoa; L:* C. monodonta, *Grotte de Sare, Pyrénées-Atlantiques; todos los ejemplares están en la Colección de G.A. y D.T. Holyoak.*

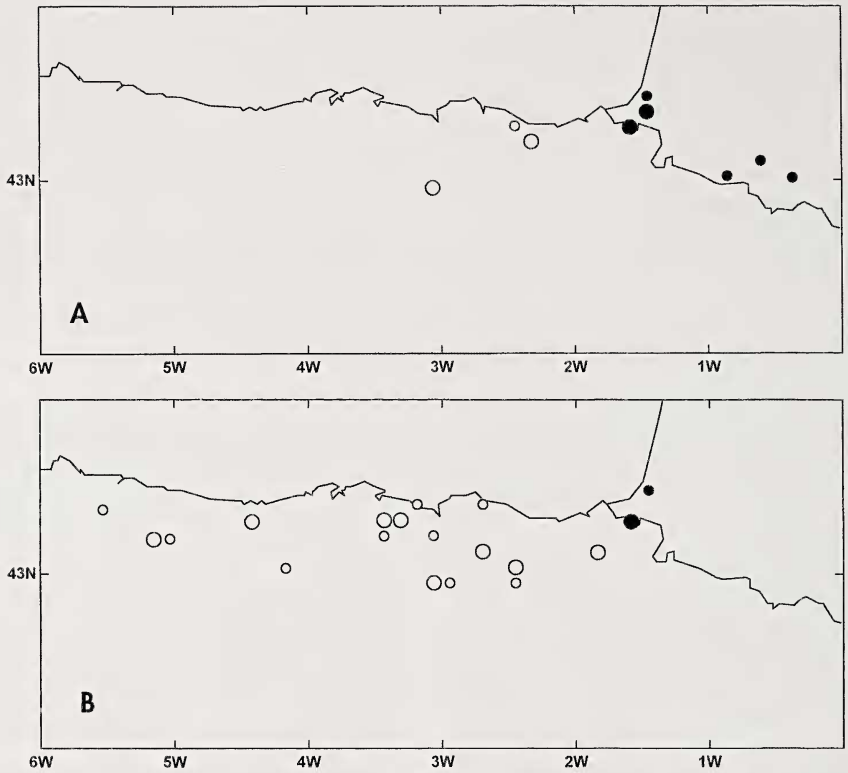

Figure 3. Distribution of some *Cryptazeca* species mapped in 10 km squares of the U.T.M. grid. A: *C. monodonta sensu lato*, closed symbols= records originally determined as *C. monodonta*, open symbols= records originally determined as *C. kobelti*, large symbols= authors' records, small symbols= records from literature; B: *C. subcylindrica sensu lato*, closed symbols= records originally determined as *C. subcylindrica*, open symbols= records originally determined as *C. vasconica*, large symbols= authors' records, small symbols= records from literature. The report of *C. monodonta* from Prov. Asturias by BECH (1986) is not mapped because the species identification seems unlikely (the shell height was given as 3.15 mm, shell breadth [erroneously?] as 3.8 mm).

Figura 3. Distribución de varias especies de Cryptazeca *en cuadrículas UTMs. de 10 km de lado. A:* C. monodonta sensu lato, *círculos negros= citas determinadas originalmente como* C. monodonta, *círculos blancos= citas determinadas originalmente como* C. kobelti, *símbolos grandes= citas de los autores, símbolos pequeños= citas procedentes de la literatura; B:* C. subcylindrica sensu lato, *círculos negros= citas determinadas originalmente como* C. subcylindrica, *círculos blancos= citas determinadas originalmente como* C. vasconica, *símbolos grandes= citas de los autores, símbolos pequeños= citas procedentes de la literatura. La cita de* C. monodonta *de la Prov. Asturias de* BECH *(1986) no ha sido representada en el mapa ya que la identificación de la especie es dudosa (la altura de la concha indicada es de 3,15 mm, su anchura [¿errónea?] es de 3,8 mm).*

that have exposed limestone rocks, sometimes under closed cover of deciduous woodland, sometimes on more open crags or limestone pavement with only scattered trees and shrubs. Litres of sievings from ground litter commonly held only a few shells and repeated visits to the same locality were often unsuccessful in finding more. Our only locality that produced a large sample (32 snails or shells, 12 of them living) was at the damp bottom of a solution hollow in limestone pavement, 5 m below the ground surface, where permanently shaded by the

surrounding rocks and by trees (W. of Ranero, Prov. Vizcaya). The species is also reported from inside caves (see above). Overall, this species appears much more closely restricted to sheltered and shaded rock crevices than *C. monodonta*, with no confirmed occurrences in woodland leaf-litter at sites lacking exposed rocks.

DISCUSSION

Revised key to *Cryptazeca* species

Reduction of the number of species recognised within *Cryptazeca* greatly simplifies identification of its species. The key to adult shells presented by GÓMEZ (1990b: 373) can be revised as follows:

1 - Shell height > 5.5 mm (cave species) 2
- Shell height < 5.5 mm (in open habitats or caves) 3

2 - Shell height/shell breadth > 2.8 . . . . . *C. elongata*
- Shell height/shell breadth < 2.8 . . . . . *C. spelaea*

3 - Shell height/shell breadth > 2.35, shell with strong transverse sculpture . . . . . *C. subcylindrica*
- Shell height/shell breadth < 2.35, shell with transverse sculpture weak or nil . . . . . *C. monodonta*

Conservation status of the enlarged *C. monodonta* and *C. subcylindrica*

Three of the four taxa of *Cryptazeca* discussed above are included in the IUCN Red List (Mollusc Specialist Group, 1996): *C. kobelti* as Endangered (under criteria B1 + 2c), *C. monodonta* and *C. subcylindrica* both as Vulnerable (under criterion D2), whereas *C. vasconica* is regarded as Lower Risk/near threatened. Two of the taxa are now protected by law in France, as Mollusque protégés, *C. monodonta* under Article 4, *C. subcylindrica* as a Rare species under Article 1. Our proposal to regard *C. kobelti* as conspecific with *C. monodonta* adds three French localities with modern records to those in Spain, thus increasing the species' range and presumably reducing its global threat status to Vulnerable. Nevertheless, it remains a localised endemic occurring only in sites that are species-rich for land-snails and which need to be protected (see Appendix). The proposal to regard *C. vasconica* as conspecific with *C. subcylindrica* will greatly increase the species' range and number of localities with modern records, presumably implying that the overall threat status should be Lower Risk/near threatened (i.e. no longer on the Red List).

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APPENDIX. MATERIAL STUDIED.

Data are listed in sequence as province, locality name, habitat description, associated species, altitude, U.T.M. grid reference, date, collectors' initials, collector's field number, number of shells or specimens (immature or adult, whether alive or dead when collected), collection, registration number if any. Abbreviations: CGAH = Collection of G.A. & D.T. Holyoak, DTH = D.T. Holyoak, GAH = G.A. Holyoak, MH = M. Holyoak, MBS = M.B. Seddon, NHMUK = Natural History Museum, London, U.K.; NMW.Z. = Department of BioSYB, National Museum and Gallery of Wales, Cardiff, U.K.; sh = shells, sp = spirit specimens.

C. kobelti SPAIN, Prov. Alava: by N625 *ca* 3 km S. of Orduña, steep limestone hillside with *Fagus* woodland, damp beneath, with few saplings & bushes, "*ca* 610 m alt.", VN3, 26 Aug. 1984, DTH, MH, MBS, 43 sh (adults & immatures, alive & dead), NMW.Z.1993.052.10453; by A625 *ca* 3 km S. along road from Orduña, from leaf-litter on N.-facing slope in beechwood, *ca* 540 m alt., 30T 049797/47574, 9 June 2007, GAH, DTH, site 33, 6 sh (adults, alive), CGAH; by A625 *ca* 4 km S. along road from Orduña, from leaf-litter on N.-facing slopes in beechwood, *ca* 570 m alt., 30T 04977/47557, 9 June 2007, GAH, DTH, site 34, 5 sh (2 immatures & 3 adults, alive & dead), CGAH; Prov. Guipúzcoa: E. of Madariaga (NW. of Azkoitia), N.-facing slope with few limestone crags, under mature beech wood, 656 m alt., 30T 05560/47840, 8 May 2011, GAH, DTH, site E148, 1 sh (adult, alive), CGAH; E. of Madariaga (NW. of Azkoitia), N.-facing slope with few limestone crags & beech wood, 675 m alt., 30T 05551/47842, 9 May 2011, GAH, DTH, site E149, 6 sh (1 adult & 5 immatures, alive & dead), CGAH.

C. monodonta FRANCE, Dept. Pyrénées-Atlantiques: "Basses-Pyrénées", Ex. A.M. Norman Coll. (Ex Morelet), 3 sh, NHMUK.1958.9.3.1-3; 1 km SW. of Ustaritz (*ca* 8 km NW. of Cambo), mixed deciduous wood with *Corylus* understorey in valley of small stream, 24 Aug. 1980, DTH, 23 sh (alive & dead), NMW.Z.1993.052.04432; near Grotte de Sare, 5.5 km S. of Sare, mixed deciduous wood on rocky limestone slope, moss-rich ground vegetation, 23 Aug. 1980, DTH, 29 sh (alive & dead), NMW.Z.1993.052.04408; Grotte de Sare, rocky limestone slope, shaded by mixed deciduous trees, very mossy with dead wood lying, *ca* 300 m alt., XN1, 6 Aug. 1983, DTH, MBS, 6 sh, NMW.Z.1993.052.07652; Grotte de Sare, rocky limestone slopes shaded by mixed deciduous wood, moist & mossy, XN1, 28 Aug. 1984, DTH, MH, MBS, 56 sh (dead), NMW.Z. 1993.052.10528; near Grotte de Sare, limestone slopes near stream in deciduous woods, *ca* 200 m alt., 43°16' N., 1°34'W., 19 May 2001, GAH, 4 sh (adults, alive & dead), CGAH; Grotte de Sare, rocky limestone slope with deciduous woodland cover, 220 m alt., 30T 061587/479160, 7 May 2011, GAH, DTH, site F146, 1 sp & 11 sh (6 adults [1 damaged] & 6 immatures, 1 alive & 10 dead), CGAH.

C. subcylindrica FRANCE: Dept. Pyrénées-Atlantiques: near Grotte de Sare, 5.5 km S. of Sare, mixed deciduous wood on rocky limestone slope, moss-rich ground vegetation, with *Cryptazeca monodonta*, 23 Aug. 1980, DTH, 3 sh (2 immatures & 1 adult, dead), NMW.Z.1993.052.04420; Grotte de Sare, rocky limestone slope, shaded by mixed deciduous trees, very mossy with dead wood lying, *ca* 300 m alt., XN1, 6 Aug. 1983, DTH, MBS, 1 sh (immature, dead), NMW.Z.1993.052.07653; Grotte de Sare, rocky limestone slopes shaded by mixed deciduous wood, moist & mossy, XN1, 28 Aug. 1984, DTH, MH, MBS, 5 sh (1 immature & 4 adults, alive & dead), NMW.Z.1993.052.10530; Grotte de Sare, rocky limestone slope with deciduous woodland cover, 220 m alt., 30T 061587/479160, 7 May 2011, GAH, DTH, site F146, 2 sh (1 adult & 1 immature, dead), CGAH.

C. vasconica SPAIN, Prov. Alava: by N625 *ca* 3 km S. of Orduña, steep limestone hillside with *Fagus* woodland, damp beneath, with few saplings & bushes, *ca* 610 m alt., VN3, 26 Aug. 1984, DTH, MH, MBS, 3 sh (dead), NMW.Z.1993.052.10455; Prov. Asturias: near AS261, by San Ignacio, limestone scree on wooded slope by stream bank, *ca* 270 m alt., [approximately] 30T 03302/47871, 24 June 2007, GAH, site 46, (5 adults & 5 immatures, dead), CGAH; near N625 in N. part of Desfiladero de los Beyos (by turn to San Ignacio), base of limestone crag with ledges, scree & ephemeral waterfall, shaded by low deciduous woodland, 184 m alt., 30T 032997/478728, 13 May 2011, GAH, DTH, site E159b, 3 sh (2 adults [1 broken] & 1 immature, dead), CGAH; Prov. Cantabria: just SE. of Llaguno (SW. of Castro-Urdiales), limestone road-cutting, crag & deciduous woodland on slope, 252 m alt., 30T 04786/47940, 10 May 2011, GAH, DTH, site E153, 8 sh (2 adults & 6 immatures, 3 alive & 5 dead), CGAH; S. of CA250 just NW. of Otañes, base of limestone crag with few oak trees, block-scree locally, 136 m alt., 30T 04830/47985, 10 May 2011, GAH, DTH, site E152, 5 sh (3 adults & 2 immatures, dead but 1 shell fresh), CGAH; Prov. Guipúzcoa: by GI3592 NE. of Araotz, rocky limestone slopes & crags, above river, with patchy scrub & low woodland, 398 m alt., 30T 05459/47610, 9 May 2011, GAH, DTH, site E150, 3 sh (adults, alive), CGAH; Prov. Navarra: by NA4150 *ca* 2 km E. of Puerto de Usateguieta, rocky limestone slopes with deciduous woodland (mainly beech), 644 m alt., 30T 059231/477150, 8 May 2011, GAH, DTH, site E147, 2 sh (1 adult & 1 immature, alive & dead), CGAH; Prov. Vizcaya: W. of Ranero (E. of Ramales de la Victoria), from litter at base of deep shaded hollows on limestone slope, *ca* 500 m alt., 30T 04692/47902, 14 & 15 June 2007, GAH, DTH, site 40, 3 sp & 29 sh (18 adults [1 broken] & 14 immatures, 12 alive & 20 dead), CGAH; by BI2543 near Dima, rocky limestone slope with crags and patches of Hazel coppice, 247 m alt., 30T 05209/47746, 9 May 2011, GAH, DTH, site E151, 4 sh (2 adults & 2 immatures, 1 alive & 3 dead), CGAH.